National Aeronautics and Space Administration

NOAA-L Press Kit

July 2000

NOAA-L Contacts

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NASA, NOAA TO LAUNCH NEW ENVIRONMENTAL SATELLITE NOAA-L

A new environmental satellite, the National Oceanic and Atmospheric Administration's NOAA-L spacecraft, is being prepared for a launch date of August 29 from Vandenberg Air Force Base, Calif. The NOAA-L spacecraft will lift off aboard a Titan II launch vehicle at 3:22 a.m. PDT (6:22 a.m. EDT). The launch window extends for approximately 10 minutes.

The NOAA-L satellite will improve weather forecasting and monitor environmental events around the world. NOAA-L is the second in a series of five Polar Operational Environmental Satellites (POES) with improved imaging and sounding capabilities that will operate over the next 12 years. Like other NOAA satellites, NOAA-L will collect meteorological data and transmit the information to users around the world to enhance weather forecasting. The data will be used primarily by NOAA's National Weather Service for its long-range weather and climate forecasts. The satellite will continue the support of the international COSPAS-SARSAT system by providing search and rescue capabilities essential for detection and location of ships, aircraft, and people in distress.

The polar-orbiting satellites monitor the entire Earth, tracking atmospheric variables and providing atmospheric data and cloud images. They track global weather patterns affecting the weather and climate of the United States. The satellites provide visible and infrared radiometer data for imaging purposes, radiation measurements, and temperature and moisture profiles. The polar orbiters' ultraviolet sensors also measure ozone levels in the atmosphere and are able to detect the ozone hole over Antarctica from mid-September to mid-November. Each day, these satellites send global measurements to NOAA's Command and Data Acquisition station computers, adding vital information to forecasting models, especially over the oceans, where conventional data is lacking.

NOAA's environmental satellite system is composed of two types of satellites: Geostationary Operational Environmental Satellites (GOES) for national, regional, short-range warning and "now-casting"; and the polar-orbiting satellites for global, long-term forecasting and environmental monitoring. Both GOES and POES are necessary for providing a complete global weather monitoring system. Both also carry search and rescue instruments to relay signals from aviators and mariners in distress. These satellites are operated by NOAA's National Environmental Satellite, Data, and Information Service in Suitland, Md.

NASA's Goddard Space Flight Center in Greenbelt, Md., is responsible for the construction, integration, launch and verification testing of the spacecraft, instruments and unique ground equipment. NASA turns health and safety control of the NOAA-L spacecraft over to NOAA 10 days after launch. NASA's comprehensive on-orbit verification period is expected to last until approximately 45 days after launch when NASA will hand over formal NOAA-L operations to NOAA. Lockheed Martin Missiles and Space Co., Sunnyvale, Calif., built the spacecraft, under contract to Goddard.

Data from the NOAA spacecraft issued by researchers within NASA's Earth Science Enterprise, a long-term research program designed to study Earth's land, oceans, atmosphere, ice and life as a total integrated system. In addition, this data is helping NASA scientists design instruments for follow-on missions.

For more information about NOAA-L and the polar orbiting satellites, see the following web sites:
http://poes.gsfc.nasa.gov
http://www2.ncdc.noaa.gov/docs/intro.htm
http://www.osd.noaa.gov/sats/poes.htm

End of General Release

Media Services Information

NASA Launch Coverage

Live commentary and coverage of the NOAA-L launch on NASA TV will be available beginning at approximately 2:00 a.m. PDT (5:30 a.m. EDT).

Briefings

A pre-launch and science briefing is scheduled for L-1 beginning at 11 a.m. PDT (2 p.m. EDT) at Vandenberg Air Force Base. The briefing will be carried live on NASA TV.

News Center/Status Reports

The NOAA-L News Center at the NASA Vandenberg Resident Office (phone: 805-605-3051) will open beginning on L-2. Recorded status reports will be available beginning L-2 by dialing either 805-734-2693 or 301-286-NEWS.

Media Credentials

Media seeking launch accreditation should contact the Resident Office at Vandenberg AFB, Calif. by close of business two days before launch at:
805-606-3595, fax: 805-606-8303, or e-mail: pubaffairs@plans.vafb.af.mil
Requests must be on the letterhead of the news organization and specify the editor making the assignment to cover the launch.

Internet Information

Detailed information about the NOAA-L mission and science objectives can be found at the following NASA and NOAA websites:
http://poes.gsfc.nasa.gov
http://www2.ncdc.noaa.gov/docs/intro.htm
http://www.osd.noaa.gov/sats/poes.htm

NOAA-L Quick Facts

The NOAA-L spacecraft consists of a spacecraft platform provided under a NASA contract with Lockheed Martin Space Systems Company and eight instruments procured under NASA contracts with several U.S. and international entities. It also includes two search and rescue instruments.

Spacecraft:

- Main Body: 4.2 meters (13.75 feet) long, 1.88 meters (6.2 feet) diameter
- Solar Array: 2.73 meters by 6.14 meters (8.96 feet by 20.16 feet); 16.76 square meters (180.63 square feet)
- Weight at liftoff: 2,231.7 kilograms (4,920 pounds). Weight includes 756.7 kilograms of expendable fuel (1,666.7 pounds)
- Science Instruments: AVHRR/3, HIRS/3, AMSU-A1, -A2, AMSU-B, SBUV/2, SEM/2 and DCS/2
- Search and Rescue Instruments: SARR and SARP
- Power: Solar array; three nickel-cadmium batteries each consisting of two battery packs
- Load Power Requirements: 833 watts for zero degrees sun angle; 750 watts for 80 degrees sun angle
- Instrument Data Rate: 665.4 kilobits per second
- Design Lifetime: At least two years

Orbit: 470 nautical miles (870 kilometers), inclination - 98.7442 degrees to the equator
Launch Site: Western Range, Vandenberg Air Force Base, California
Launch Vehicle: Titan II, Lockheed Martin Space Systems Company
Mission Planned Launch Date: August 29, 2000
Launch Time: 3:22 a.m. PDT (10-minute window)
Spacecraft Separation: 394 seconds after launch
First Acquisition of NOAA-L Signal: 3:52 a.m. PDT (6:52 a.m. EDT), at McMurdo Tracking Facility
Cost (spacecraft and instruments): approximately $156.4 million

Program Responsibility

The Polar Operational Environmental Satellites (POES) Program at NASA's Goddard Space Flight Center in Greenbelt, Maryland, is responsible for construction, integration and verification testing of the spacecraft, instruments and unique ground equipment. The Titan II launch vehicle, a refurbished ballistic missile, is provided by the U.S. Air Force. NASA turns health and safety control of the NOAA-L spacecraft over to NOAA 10 days after launch. NASA's comprehensive on-orbit verification period is expected to last until approximately 45 days after launch when NASA will hand over formal NOAA-L operations to NOAA. NOAA also determines the need for satellite replacement and designs, develops and operates the ground system needed to acquire, process and disseminate the satellite data.

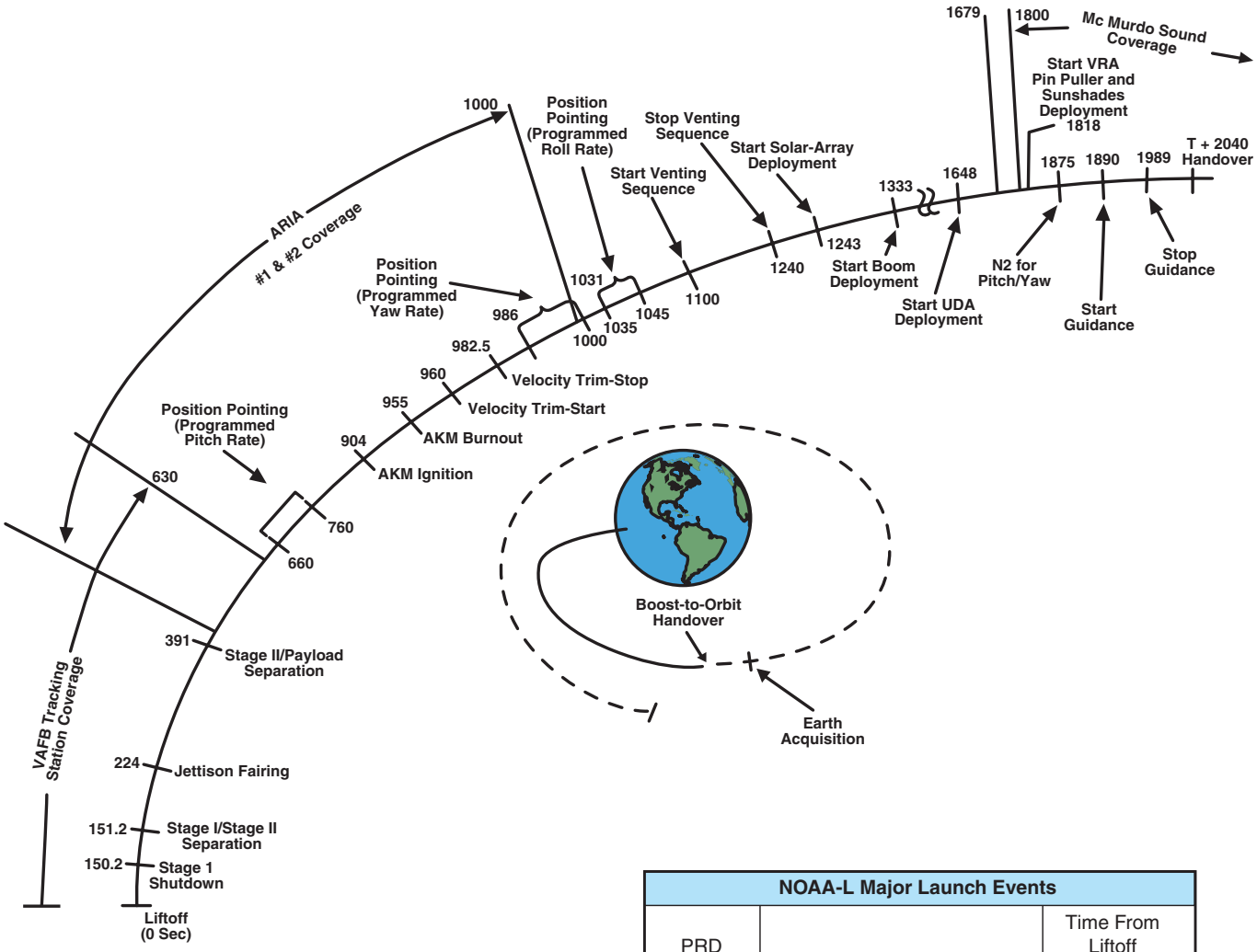
Launch Time/Date/Site

The satellite is planned to launch at 3:22 a.m. PDT (6:22 a.m. EDT) on August 29, 2000 from Vandenberg Air Force Base (VAFB), California.

Launch Operations

NASA's Kennedy Space Center will conduct launch operations at the VAFB.

NOAA-L ORBIT LAUNCH SEQUENCE



NOAA-L Major Launch Events		
PRD 1700#	Event	Time From Liftoff (seconds)
1	Liftoff (L/O)	T-0
2	Stage 1 Shutdown	150.2
3	Stage I/Stage II Separation	151.2
4	Jettison Fairing	224.0
5	Stage II/Payload Separation	391.0
-	Pitch Rate - Start	660.0
-	Pitch Rate - Stop	760.0
6	AKM Ignition	904.0
7	AKM Burnout	955.0
-	Start Velocity Trim	960.0
8	End Velocity Trim	982.5
9	Start Venting Sequence	1100.0
10	Stop Venting Sequence	1240.0
11	Solar Array Deployment	1240.0
12	Boom Deployment	1333.0
13	Solar Array Mast Deploy	1485.0
14	SRA Antenna Deploy	1568.0
15	UDA Deployment	1648.0
16	VRA Phase I Deploy	1698.0
17	VRA Phase II Deploy	1818.0
18	Sunshades Deployment	1818.5
19	N2 for Pitch/Yaw	1875.0
20	Start Guidance	1890.0
21	Stop Guidance	1989.0
22	Handover	2040.0

Earth System Science and POES Program Objectives

Beginning in the 1960s, NASA pioneered the study of the atmosphere from the unique perspective of space with the launch of its Television Infrared Observation Satellite (TIROS-1). Thanks to new satellite and computer technologies, it is now possible to study the Earth as a global system.

Earth System Science integrates many disciplines of scientific research that focus on understanding the planet as a whole, its integral parts and how its parts interact. Through research, scientists are getting better at understanding and improving their forecasting of climate phenomena such as the onset of the 1997-98 El Niño.

Weather and climate prediction is a challenge that requires the collection of data over long periods of time. Climate changes occur over vast ranges of space and time and their causes and effects are often difficult to measure and understand. Scientists must obtain long-term data if they are to reach a clearer understanding of the interactions among the Earth's many systems. Polar-orbiting satellites provide both long-range weather forecasting and current data for global change research. Operating as a pair, two satellites ensure that non-visible data for any region of the Earth is no more than six hours old.

The NOAA satellites help to carry forth the U.S. commitment to systematic, global weather observation and provide total global coverage four times a day. The mission supports growing international cooperation in space; the spacecraft instrument suite provides data supporting requirements of 140 nations, and several instruments are provided by foreign nations. The Search and Rescue component of the program makes major contributions toward international search and rescue operations. All nations can access NOAA spacecraft data and for many, NOAA data is their sole weather forecasting reference.

The POES Program objectives contribute to NASA's Earth Science Enterprise objectives of understanding the causes and consequences of long-term climate variations on regional as well as global scales. Its objectives also support the Enterprise's objectives by providing for distribution of meteorological data to various organizations, improving the capability for forecasting and providing real-time warnings of solar disturbances and extending knowledge and understanding of the atmosphere and its processes to improve short- and long-term weather forecasts. Data from the NOAA spacecraft are helping NASA scientists design instruments for follow-on missions for NASA's Earth Sciences program.

The POES program disseminates information about the Earth system, expands scientific knowledge by characterizing the Earth system and enables productive use of Earth Sciences products in the public and private sectors.

NOAA-L SPACECRAFT CONTINUES ENVIRONMENTAL OBSERVATIONS

NASA will launch and activate the NOAA-L spacecraft, the latest in a series of polar-orbiting spacecraft that provide environmental observations for the National Oceanic and Atmospheric Administration (NOAA). Part of an active NASA-NOAA cooperative program, the NOAA satellites carry instruments that observe the Earth and provide global data for NOAA's operational user requirements including short- and long-range weather forecasts. The operational system consists of two polar-orbiting satellites.

NOAA-L is the latest in the series of advanced TIROS-N spacecraft that provide a platform to support the environmental monitoring instruments for imaging and measuring the Earth's atmosphere, its surface and cloud cover. The polar-orbiting spacecraft serve as complementary satellites to the geosynchronous Geostationary Operational Environmental Satellites (GOES) system. Whereas the GOES satellites provide near-term data for the continental United States and Hawaii to NOAA's forecasters, the polar-orbiting spacecraft provide full global data for short- and long-range forecast models, climate modeling and various other secondary missions.

Instruments on board the spacecraft monitor the entire Earth, providing atmospheric measurements of temperature, humidity, ozone and cloud images as they track weather patterns that affect global weather and climate. The satellites send millions of global measurements daily to NOAA's Command and Data Acquisition stations in Fairbanks, Alaska and Wallops Island, Va., and data processing center in Suitland, Md. These measurements add valuable information to forecasting models, especially for ocean areas, where conventional ground-based data is lacking. The spacecraft also provides a platform for the Search and Rescue Satellite Aided Tracking system, part of the COSPAS-SARSAT constellation. This international search and rescue system detects and locates emergency beacons transmitted from ships, aircraft and people in distress and has aided in saving thousands of lives.

NOAA-L forms one of a pair of orbiting operational satellites that ensure that environmental data for any region of the Earth is no more than six hours old. With its partner satellite, NOAA-L not only provides cost-effective data for very immediate and real needs but also for extensive climate and research programs. The weather data, including images that are often seen on television news programs, affords both convenience and safety to viewers throughout the world.

NOAA-L will be launched aboard a Titan II expendable space launch vehicle from Vandenberg Air Force Base, Calif. The 10-minute launch window opens at 3:22 a.m. PDT. Separation of the spacecraft from its launch vehicle will occur about 394 seconds after launch.

In its final orbital position, which is at an altitude of approximately 470 nautical miles (870 kilometers) above the Earth, it will travel in a Sun-synchronous orbit at a 99-degree inclination toward the equator. The term "Sun-synchronous" means that while the satellite orbits around the Earth, the orbit also "precesses" (rotates) eastward about the Earth's polar axis almost 1 degree per day, the same rate and direction as the Earth's average daily rotation about the Sun. This precession keeps the satellite in a constant position with reference to the Sun so that it is illuminated consistently throughout the year and so that ideally the scene and spacecraft illumination conditions repeat on a yearly cycle. The spacecraft will be launched so that it crosses the Equator at about 2:00 p.m. when travelling northbound (which gives it the designation of an "afternoon" or "p.m." satellite) and 2:00 a.m. when travelling southbound. NOAA-L takes about 102 minutes to complete one orbit around the Earth. NOAA-L will join its "a.m." spacecraft, NOAA-15, which was launched May 13, 1998.

The spacecraft was built by Lockheed Martin Space Systems Company. The instruments onboard NOAA-L include the Advanced Very High Resolution Radiometer (AVHRR/3), the High Resolution Infrared Radiation Sounder (HIRS/3), the Advanced Microwave Sounding Unit-A (AMSU-A1, A2), the AMSU-B, the Solar Backscatter Ultraviolet Radiometer (SBUV/2), the Space Environment Monitor (SEM/2) and the Data Collection System (DCS/2). In addition, it carries two search and rescue instruments, the Search and Rescue Repeater (SARR) and the Search and Rescue Processor (SARP).

The AVHRR/3 is the primary imaging system and consists of visible, near infrared (IR) and thermal IR channels. The primary sounding suite flying on NOAA-L is the HIRS/3, AMSU-A and AMSU-B, which measure atmospheric temperature and humidity. The SBUV/2 instrument is both an imager and a sounder. As an imager, it produces total column ozone maps. As a sounder, it obtains and measures the ozone distribution in the atmosphere as a function of altitude.

Instrument Payload

The AVHRR/3, built by International Telephone and Telegraph-A/CD (Fort Wayne, Ind.), is composed of six detectors: three view reflected energy in the visible portion of the electromagnetic spectrum and three view energy in the near-infrared portion of the electromagnetic spectrum. The AVHRR (which is the type of instrument called an “imager”) observes vegetation, clouds, and the surface of bodies of water, shorelines, snow, aerosols and ice. It can detect the heat in the environment, the temperature of snowcaps and the sea surface, vegetation growth around the world and forest fires. From this data, scientists on the ground can determine whether snowcaps are growing or diminishing in size, the effects of changes in ocean temperature and other changes in the environment. The instrument has a scan mirror that continuously rotates and scans the Earth at six revolutions per second to provide continuous coverage. The data generated by the AVHRR is used worldwide by scientists, commercial fisherman, teachers and many others.

The HIRS/3, built by ITT-A/CD, is an atmospheric sounding instrument. It observes “columns” in the atmosphere and obtains data from each of 20 segments (or bands) in that column. Each of these 20 bands can be associated with energy from a specific region and height in the atmosphere. By combining the data from the different bands, the instrument can generate complete temperature and moisture profiles. It can also measure how much of the Sun’s energy remains as it travels through the atmosphere.
The instrument has 19 infrared channels and one visible channel. Each channel takes measurements at a particular frequency that is associated with a particular element (or gas) in the atmosphere. These gases are principally carbon dioxide, water and ozone. These measurements allow scientists to determine the amount of each of these gases in the atmosphere and the altitude at which they appear.

HIRS/3 is used along with the AMSU instruments to produce atmospheric temperature, humidity and total ozone profiles from the Earth’s surface to about 40 kilometers (23.3 miles) altitude. The data is also used to determine ocean surface temperatures, precipitable water, cloud height and coverage and surface radiance. The instrument completes one scan every 6.4 seconds.

The AMSU-A1,-A2, built by Aerojet (Azusa, Calif.) provides data that is used along with data obtained from the HIRS to produce a new suite of microwave-based surface and hydrological products, including global atmospheric temperature and humidity profiles from the Earth’s surface

to the upper stratosphere, about 48 kilometers or 29.8 miles. Among these products are total precipitable water (water vapor), cloud liquid water, rain rate, snow cover and sea ice concentration, It has 15 channels and continuously scans the Earth's surface and the atmosphere, measuring naturally emitted microwave signals radiated by the Earth's surface and atmosphere. The microwave signals measured by AMSU-A range from 23 gigahertz (GHz) to 89 GHz. The AMSU-A is divided into two physically separate modules, each of which operates and interfaces with the spacecraft independently.

The AMSU-B, built by Matra Marconi for the United Kingdom Meteorological Office, allows the calculation of vertical water vapor profiles from the Earth's surface to about 12 kilometers or 7.5 miles from the Earth's surface. It has five channels and continuously scans the Earth's surface and the atmosphere, measuring microwave signals radiated by the Earth's atmosphere. The AMSU-B measures microwave signals from 89 GHz to 183 GHz.

The SBUV/2, built by Ball Aerospace (Boulder, Co.) is flown on the NOAA afternoon satellites. It is a long-term monitoring device that takes global measurements and observes how elements in the atmosphere change over time. The SBUV uses its 12 channels to measure the amount of radiation (or energy) that comes directly from the Sun (using a diffuser) and how much energy is reflected back from the Earth. This information is integrated into a scientific model that calculates the concentration and distribution of ozone in the stratosphere. However, the primary use of the data from the SBUV is determining the vertical distribution of ozone over the global surface - how it varies at various distances from the Earth's surface up to approximately 79 kilometers (or 49 miles). The instrument also provides for the generation of layer ozone values, which represent the amount of ozone found in a "chunk" of the atmosphere.

Each channel on the SBUV detects a particular near-ultraviolet wavelength whose intensity depends on the ozone density at a particular height in the atmosphere. It is nadir pointing, which means that it always points directly toward the center of the Earth and does not scan the atmosphere as the other POES instruments do. The SBUV has a device called a Cloud Cover Radiometer that provides information on the amount of cloud cover in an image and removes the effects of the clouds from the data.

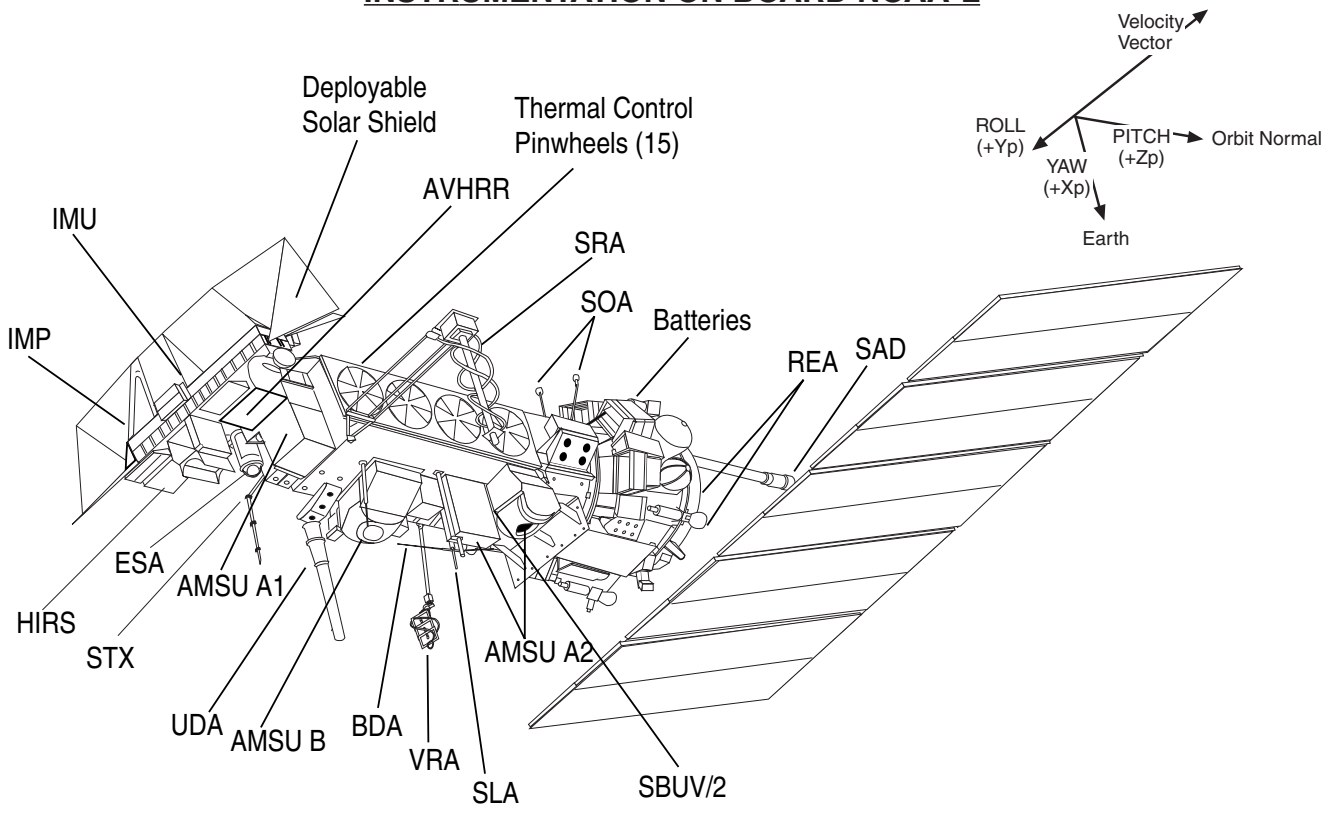
The SEM/2, built by Panametrics (Boston, Mass.) for the NOAA Space Environment Center, detects charged particles and provides measurements to determine the intensity of the Earth's radiation belts and the flux of charged particles into the atmosphere at the satellite's altitude. It provides knowledge of solar terrestrial phenomena and also warns of solar storms that may impair long-range communication and high-altitude operations, damage satellite circuits and solar panels, or cause changes in drag and magnetic torque on satellites. The instrument consists of two separate sensor units and a common Data Processing Unit (DPU). The sensor units are the Total Energy Detector (TED) and the Medium Energy Proton and Electron Detector (MEPED).

The Search and Rescue instruments on-board NOAA-L consist of a Search and Rescue Repeater (SARR), built by DND in Canada and a Search and Rescue Processor (SARP), built by CNES in France. These instruments detect distress calls sent from emergency beacons on-board aircraft and boats and carried by people in remote areas. The instruments on the spacecraft transmit the data to ground receiving stations or local user terminals (LUTs) where the location of the emergency signals is determined by Doppler processing. The LUTs forward the information to a Mission Control Center where further processing of the information occurs. The information is then sent to a Rescue Coordination Center that effects the search and rescue. Since

its inception in 1982, the COSPAS-SARSAT system has contributed to saving more than 10,000 lives. The SARR accepts signals from emergency ground transmitters at 121.5 MHz, 243 MHz and 406.05 MHz and uptranslates, multiplexes and transmits these signals at L-band to the LUTs. The SARP is a receiver and processor that receives 406.05-MHz signals from emergency ground transmitters and demodulates, processes, stores and relays the data to the next LUT that is within range of the SARP.

The Data Collection System (DCS) provided by CNES in France measures environmental factors such as atmospheric temperature and pressure and the velocity and direction of the ocean and wind currents. Data is collected from transmitting devices on platforms in the form of buoys, free-floating balloons and remote weather stations. Transmitters are even placed on migratory animals, sea turtles, bears and other animals. Data is transmitted to the spacecraft for storage and subsequent transmission from the satellite to the ground. The stored data is transmitted once per orbit. Subsequently, the data is sent to the French Centre at the Centre National D' Etudes Spatiales (CNES) in Toulouse, France and the Service Argos Facility in Lanham, Md., for processing, distribution to users and storage for archival purposes.

INSTRUMENTATION ON BOARD NOAA-L



LEGEND

AMSU	Advanced Microwave Sounding Unit	*MEPED	Medium Energy Proton/Electron Detector	SRA	Search-and-Rescue Receiving Antenna
AVHRR	Advanced Very High Resolution Radiometer	REA	Reaction Engine Assembly	STX	S-Band Transmitting Antenna (1 of 4 shown)
BDA	Beacon Transmitting Antenna	SAD	Solar Array Drive	SOA	S-Band Omni Antenna (2 of 6 shown)
*DCS	Data Collection System	*SAR	Search and Rescue	*TED	Total Energy Detector
ESA	Earth Sensor Assembly	SBUV/2	Solar Backscatter Ultraviolet Radiometer	UDA	Ultra High Frequency Data Collection System Antenna
HIRS	High Resolution Infrared Radiation Sounder	SEM	Space Environment Monitor		
IMP	Instrument Mounting Platform	SLA	Search and Rescue Transmitting Antenna (L-Band)	VRA	Very High Frequency Real-time Antenna
IMU	Inertial Measurement Unit				

Data Products

The polar operational environmental satellites collect global data on cloud cover; surface conditions such as ice, snow and vegetation; atmospheric temperatures; and moisture, aerosol and ozone distributions; and collect and relay information from fixed and moving data platforms.

Data from the six NOAA-L instruments will be used to produce dozens of data products on different facets of the Earth system. The SBUV/2 provides for the generation of individual ozone profiles and layer ozone values from the Earth's surface to its upper atmosphere. The AVHRR routinely produces sea surface temperature products at global, regional, local and coastal coverages. The AVHRR also generates vegetation condition products that show areas with severe vegetation stress. The AMSU-A and AMSU-B instruments allow for the generation of global total precipitable water, cloud liquid water, rain rate, snow cover and sea ice concentration products in cloudy regions where traditional visible and infrared instruments have decreased capability. The HIRS/3 and AMSU-A combine to generate atmospheric temperature products on multiple levels.

For over 30 years, NOAA has freely and openly provided satellite data through direct broadcast to users in the United States and in 100 other countries throughout the world. In the United States, any commercial firm receiving data through direct readout may provide tailored products to customers and/or viewers. In addition, POES data products are made available to users in the United States and throughout the world through NOAA's Satellite Active Archive.

SPACECRAFT COMMUNICATIONS

The spacecraft transmits the instrument data to the ground for three primary functions: Command and Data Acquisition (CDA), Direct Broadcast and Search and Rescue.

Command and Data Acquisition (CDA) Station Downlinks: High Resolution Picture Transmission (HRPT) provides real-time transmission to "users" of digital data at an imagery carrier frequency of 1698, 1702.5, or 1707 MHz with a data rate of 665.4 kbps. HRPT is available for users with the necessary receiver and data handling/processing equipment. A frequency of 1702.5 MHz can be used for HRPT, but utilizes the opposite antenna polarization (left circular).

Global Area Coverage (GAC) 4-kilometer (2.5-mile) resolution AVHRR imagery provides recorded data for transmission to NOAA ground CDA stations.

Local Area Coverage (LAC) provides recorded 1-kilometer (0.62-mile) resolution AVHRR imagery. LAC output is supplied only to the spacecraft digital tape recorder (DTR) input selector for recording of pre-scheduled selected areas. The recorded data is transmitted to the NOAA CDA stations.

Direct Broadcast Downlinks: There are three types of direct broadcast downlinks: 1) the real-time HRPT, 2) the direct sounder broadcast (DSB), also referred to as the real-time VHF beacon transmissions and 3) the Automatic Picture Transmission (APT).

- **High Resolution Picture Transmission (HRPT):** HRPT provides worldwide direct readout of full resolution spacecraft parameters and instrument data to ground stations within the footprint of the NOAA polar orbiters. The HRPT service was originally designed to provide timely day and night sea surface temperature, ice, snow and cloud cover information to diverse users, but applications have expanded due to the proliferation of moderately priced equipment and software. HRPT transmissions contain data from all instruments aboard the NOAA polar satellites. The data stream includes information from the TIROS Information Processor (TIP) and from the AVHRR/3 providing five of six channels at 1-kilometer (0.62-mile) resolution. The TIP contains spacecraft attitude data, time codes, housekeeping and low rate instrument science data from the HIRS/3, SEM/2, DCS/2 and the SBUV. The AMSU-A, AMSU-A1, AMSU-A2 and AMSU-B are also included in HRPT from the AMSU Information Processor (AIP).

  To receive the data, users can purchase the necessary equipment (computer, software, antenna) from commercial companies for unlimited access to the HRPT signals. In 1996, there were 541 HRPT receivers worldwide registered with the World Meteorological Organization (WMO).

- **Direct Sounder Broadcasting (DSB):** Very high frequency (VHF) beacon transmission is available to users who do not intend to install the more complex equipment necessary to receive high data rate S-band service. The lower data rates permit the user to install less complex, less costly equipment to receive the data (HIRS/3, SEM/2, DCS/2, but not AMSU). Parallel outputs are provided for the DSB real-time VHF beacon transmission and for the Manipulated Information Rate Processor (MIRP) HRPT S-band links. The instrument data is multiplexed with analog and digital housekeeping data. The TIP output directly modulates the beacon transmission. The data is transmitted as an 8.32 kbps split phase signal over one of the beacon transmitters at 137.35 MHz and 137.77 MHz.

- **Automated Picture Transmission (APT) Data:** APT is smoothed 4-kilometer (2.5-mile) resolution IR and visible imagery derived from the AVHRR/3 instrument and transmitted within the footprint of the NOAA polar orbiters. Since APT is captured on low-cost VHF ground stations, it is also very popular in schools. Users purchase the necessary equipment (computer, software, and antenna) from commercial companies for unlimited access to APT signals. In 1996, there were 2,296 APT receivers worldwide registered with the WMO.

  Any two of the five AVHRR channels provided to the MIRP can be selected and processed as "Video A" and "Video B." One APT line, consisting of one line of Video A and one line of Video B, is output every third AVHRR scan. Ancillary AVHRR data appears at one edge of each line and their 64-second repetition period defines the APT frame length. The resulting line rate is two per second. The data is transmitted continuously over a dedicated VHF link as an analog signal consisting of an amplitude-modulated 2400-Hz subcarrier frequency modulating the RF carrier at 137.50 MHz or 137.62 MHz.

SEARCH AND RESCUE DOWNLINKS: The Search and Rescue instruments are part of the international COSPAS-SARSAT system designed to detect and locate Emergency Locator Transmitters (ELTs), Emergency Position-Indicating Radio Beacons (EPIRBs), and Personal Locator Beacons (PLBs) operating at 121.5, 243, and 406.05 MHz. The NOAA spacecraft carries two instruments to detect these emergency beacons: the Search and Rescue Repeater (SARR) provided by Canada and the Search and Rescue Processor (SARP-2) provided by France. Similar instruments are carried by the Russian COSPAS polar-orbiting satellites.

The SARR transponds the signals of 121.5, 243, and 406.05-MHz emergency beacons. However, these beacon signals are detected on the ground only if the satellite is in view of a ground station known as a Local User Terminal (LUT). The SARP detects the signal only from 406.05-MHz beacons but stores the information for subsequent down-link to a LUT. Thus, global detection of 406.05-MHz emergency beacons is provided. After receipt of information from a satellite's SARP or SARR, a LUT locates the beacons by Doppler processing. The 121.5-MHz and 243-MHz beacons are located with an accuracy of approximately 20 km (12.4 mi), whereas the 406.05-MHz beacons are located with an accuracy of approximately 4 km (2.5 mi). The LUT forwards the located information to a corresponding Mission Control Center (MCC), which, after further processing, forwards the information to an appropriate Rescue Coordination Center that effects search and rescue.

The U.S. fishing fleet is required to carry 406.05-MHz emergency beacons. The 406.05-MHz beacons are also carried on most large international ships, some aircraft, and pleasure vessels, as well as on terrestrial carriers. The 121.5-MHz and 243-MHz beacons are required on many small aircraft with a smaller number carried on maritime vessels.

SATELLITE OPERATIONS CONTROL CENTER (SOCC)

The control center for satellite operations is located at NOAA's National Environmental Satellite, Data and Information Service (NESDIS) at Suitland, Md. The SOCC is responsible for operational control of the entire ground system and the following areas:

CDA Stations - The primary command and data acquisition stations are located at Fairbanks, Alaska and Wallops Island, Va. Through a cooperative agreement between NOAA/NESDIS and the Establissement d'Etudes et de Reserches Meteorologiques in France, real-time TIP data can be relayed from the Lannion Centre de Meteorologie Spatiale (CMS) in France via a data link provided by NOAA to the United States.

The CDA stations transmit commands to the satellites and acquire and record environmental and engineering data from the satellites for retransmission to the SOCC. All data and commands are transmitted between the SOCC and the CDAs via commercial communications links.

Ground Communications - The ground communications links for satellite operations are provided by the Satellite Communications Network (SATCOM) and NASA Communications Network (NASCOM). NASCOM provides any launch-unique communications links for satellite launch. SATCOM provides all voice and data links between SOCC and the CDA stations after launch. SATCOM is provided and operated by NESDIS.

NESDIS Central Environmental Satellite Computer System (CEMSCS)

CEMSCS acquires the data from the CDA stations via the SOCC and is responsible for data processing and the generation of meteorological products on a timely basis to meet the POES program requirements. NOAA provides all hardware and software for CEMSCS. NOAA will provide ephemeris data.

SAR GROUND SYSTEM (LUTS AND MCCS)

The U.S. LUTs are located at Fairbanks, Alaska; Vandenberg AFB, Calif; Wahiawa, Hawaii; Johnson Space Center, Houston, Texas; NOAA, Suitland, Md.; Anderson AFB, Guam; and Sabana SECA, Puerto Rico. The LUTs receive the SAR data from the satellite, determine the distress location and forward the data to the MCC at Suitland, Md. The MCC determines the proper Rescue Coordination Center and forwards the distress location data after removing redundant information. There are also MCCs and LUTs in Canada, France, Russia and 10 other cooperating countries. All MCCs cooperate in forwarding data to provide rapid global delivery of distress locations received through the satellites.

GODDARD SPACE FLIGHT CENTER FACILITY SUPPORT

The Office of Space Communications (OSC) associated support is requested through the Mission Requirements Request (MRR) and the Detailed Mission Requirements (DMR) Document, with other support as described in Memoranda of Understanding. NASA/GSFC provides nominal prelaunch orbital and prediction information, special support for initial orbit estimation and initial quality control checks of the North American Air Defense (NORAD) orbital data. All ground attitude determination is to be accomplished by the NOAA central data processing facility.

THE NORTH AMERICAN AIR DEFENSE COMMAND (NORAD)

NORAD has prime responsibility for orbit determination, which includes establishing the initial orbit solution and providing updated orbital parameters routinely throughout the life of the mission.

LAUNCH, EARLY ORBIT AND CONTINGENCY DOWNLINK

An S-band downlink operating at 2247.5 MHz is used during satellite ascent to recover TIP boost telemetry through Western Range tracking sites. During on-orbit operations, orbit mode TIP will be available on this link to provide early-orbit and contingency support through the ground tracking network operated by the Air Force Satellite Control Network (AFSCN) in Sunnyvale, Calif., and the Jet Propulsion Lab (JPL) Deep Space Network (DSN). The DSN provides contingency command uplink capability. The McMurdo Tracking Facility in Antarctica also provides early orbit telemetry and command support.

PROGRAM MANAGEMENT

NASA/GSFC is responsible for the construction, integration and verification testing of the spacecraft, instruments and unique ground equipment. NASA coordinates the launch of the spacecraft with the U.S. Air Force. NASA turns health and safety control of the NOAA-L spacecraft over to NOAA 10 days after launch. NASA's comprehensive on-orbit verification period is expected to last until approximately 45 days after launch when NASA will hand over formal NOAA-L operations to NOAA.

NOAA is responsible for program requirements funding and the on-orbit operation of the multi-satellite system. NOAA also determines the need for satellite replacement. NOAA designs, develops and operates the ground system needed to acquire, process and disseminate the satellite data.

NASA Program Management:

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Acronym Appendix

AMSU ..... Advanced Microwave Sounding Unit
APT ..... Automatic Picture Transmission
AVHRR ..... Advanced Very High Resolution Radiometer
COSPAS ..... Russian Space Systems for the Search of Vessels in Distress
DCS ..... Data Collection System
DSB ..... Direct Sounder Broadcasting
GSFC ..... Goddard Space Flight Center
HIRS ..... High Resolution Picture Transmission
LUT ..... Local User Terminal
MSU ..... Microwave Sounding Unit
NESDIS ..... National Environmental Satellite, Data, and Information Service
NOAA ..... National Oceanic and Atmospheric Administration
NORAD ..... North American Air Defense Command
POES ..... Polar Operational Environmental Satellite
SAR ..... Search and Rescue
SARP ..... Search and Rescue Processor
SARR ..... SAR Repeater
SBUV ..... Solar Backscatter Ultraviolet Radiometer
SEM ..... Space Environment Monitor
SOCC ..... Satellite Operations Control Center